**NATIONAL TRANSPORTATION SAFETY BOARD**
**Office of Railroad, Pipeline, and Hazardous Materials Investigations**
**Washington, D.C. 20594**

**May 15, 2008**

# HUMAN PERFORMANCE GROUP CHAIRMAN'S FACTUAL REPORT

## A. ACCIDENT

| | |
|---|---|
| Carrier: | Dixie Pipeline Company |
| Equipment: | Pipeline |
| Location: | Carmichael, Mississippi |
| Date: | November 1, 2007 |
| Time: | About 10:35 a.m., cdt |
| Accident Number: | DCA-08-MP-001 |

## B. HUMAN PERFORMANCE GROUP

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## C. SUMMARY OF THE ACCIDENT

On November 1, 2007, at about 10:35:02 a.m. central daylight time, a 12-inch diameter pipeline operated by Dixie Pipeline Company was transporting liquid propane at about 1405 psig when it ruptured in a rural area near Carmichael, Mississippi. Upon being released to the lower pressure of the atmosphere, the liquid propane changed to gas. The resulting gas cloud expanded over nearby homes and ignited as a large fireball, which was heard and seen from miles away. The ensuing fire resulted in the death of 2 people, 7 people with minor injuries, destruction of four homes, damage to several other homes, evacuation of 60 families, and a burned area of about 71.4 acres of mostly grassland/woodland. Approximately 10,253 barrels (430,500 gallons) of propane were ultimately released. Dixie Pipeline Company reported that the cost of the accident, including the loss of product, was $3,377,247

## D. DETAILS OF THE INVESTIGATION

### 1. Behavioral Factors

72-hour work/rest history. The pipeline controller described his work/rest history during the three days before the accident.

During the 3 days leading up to the accident, the pipeline controller worked similar 12-hour shifts, from 5:30 a.m. to 5:30 p.m. On the day of the accident (Thursday November 1, 2007) the controller had awakened at 4:00 a.m., after sleeping for 7 hours. He had a 45 minute commute to work, and arrived about 5:00 a.m. He was on duty for about 5 hours when the accident occurred (approximately 10:35 a.m.). His work/rest routine was very similar on each of the three days (October 29-31) leading up to the accident. Each day, he had awakened about 4:00 a.m., arrived at work about 5:00 a.m., and was on duty from 5:30 a.m. to 5:30 p.m. After returning home from work, he would eat dinner and spend time with his family, and go to bed between 8:00 p.m. and 9:00 p.m. Each night he had slept between 7 - 8 hours, and woke up feeling adequately rested.

### 2. Medical Factors

*Health*. The pipeline controller, 25, indicated that he was in good health. His hearing and vision are normal. He was not taking any prescription or non prescription medications at the time of the incident.

*Postaccident Toxicology*. Per federal regulations pertaining to post accident toxicological testing, the pipeline controller provided a urine specimen, and was administered a breathalyzer test, to detect the presence of drugs and alcohol, respectively. Results were negative for alcohol and illicit drugs.

3. Operational Factors

*Training and Experience*. The pipeline controller involved in this accident began his training as a pipeline controller in March, 2006, and became a qualified controller in June, 2006. He was trained and operated only on the line where the accident occurred. Prior to becoming a pipeline controller he had worked just over a year as a utility technician with Dixie Pipeline in Georgia.

*Initial and Recurrent Training*. The training protocol for the pipeline controller was typical of other controller trainees at Dixie Pipeline. He had successfully progressed through the various stages of training (discussed below). Controller trainees are evaluated on the material and their performance throughout the training process.

Pipeline controller trainees begin their training by learning the necessary procedures, manuals, rules and regulations governing the safe operation of the pipeline. Later on - and for the majority of their training - they are assigned to a senior controller, primarily working on the SCADA (Supervisor Control and Data Acquisition) system.[1] During their training, controller trainees are required to demonstrate competence in several areas, including product flow, rates, pressures, alarms, hydraulics, values, and turbines.

About a month into their training, controller trainees practice on a pipeline simulator, where a physical pipeline is presented on the computer screen, along with the associated product pressure and flow rates. Controllers are required to respond to different scenarios, including leaks and alarms in the system.

Training also involves a simulation of an incident - such as a product release - on the actual pipeline system. (These scenarios may involve every location along the pipeline system). The appropriate response to these scenarios may require controller trainees to shutdown and isolate a section of pipeline, and exchange information with officials from the community involved in the incident.[2]

*Training Completed*. The accident pipeline controller's training and evaluation included the following areas:

Plan and Implement Critical Flow Path (March 2006)
Stoner Operator Qualification (OQ) Simulations training modules (March 2006)
Perform an Emergency Shutdown of a Pipeline (May 2006)

[1] SCADA—Supervisory Control and Data Acquisition—systems are a type of industrial control system used to collect data and exercise control from a remote location. In the pipeline industry, SCADA systems are used to collect data from pipeline sensors in real time and display these data to humans (controllers) who monitor the data from remote sites. Controllers, in turn, can use the SCADA system to input commands that remotely operate pipeline control equipment, such as valves and pumps. SCADA systems are widely in use in oil, gas, electricity, and municipal water systems.

[2] Qualified controllers are also involved in these simulations.

Perform Operations in Control Center (June 2006; March 2007)
Isolate a Leak (June 2006).

*Additional training included*:
Cavern operations; pumps; turbines; and valves.

The Pipeline Controller's Detection of the Leak in the Pipeline, and Subsequent Emergency Response Actions.[3]

The pipeline controller told investigators that the first indication of a problem in the pipeline system occurred at 10:35:07 a.m. CDT. Specifically, the SCADA system's computers displayed the following data related to the rate of change (ROC) in pressure at Carmichael Station: Flow: 6039 BBLH; Discharge: 1079 PSIG; Suction: 513 PSIG. Information presented on the next computer scan (10:35:13) indicated the following information related to Carmichael Station: Flow: 7126 BBLH; Discharge pressure dropped to 154 PSIG (The pipeline controller told investigators, "That's a huge drop."); and the Suction dropped to 146 PSIG. Additionally, Carmichael Station's Unit 2 pump went off (due to low suction). Based on all this information, the controller believed that he either had problems with a transmitter line, or the pipeline experienced a catastrophic failure. The pipeline controller deduced, however, that the pipeline might have been breached. (The pipeline controller told investigators, "When you get a low suction alarm on the station like that, and pressure loss, it indicates a leak.")

About the same time (less than 40 seconds later), the SCADA system indicated that the ROC in pressure at Butler Station (the next station downstream of Carmichael) was starting to come down. Additionally, the ROC in pressure at Yellow Creek Station (the next pumping station upstream of Carmichael) had also decreased. This additional information - indicating that two separate stations were experiencing similar problems - further supported the controller's belief that there was a leak in the pipeline system.

With the information he had received thus far, the pipeline controller determined that the leak was in the area of Carmichael. To reduce the amount of product in that area, at 10:37:12 he started Unit 1 pump at Butler to pull product downstream and away from the Carmichael Station.[4] Then, the pipeline controller, per company procedures, began shutting down the main line. He immediately shut down the pump at Yellow Creek, and closed off Yellow Creeks Station's suction valve to prevent additional product being sent toward Carmichael. Because product was still being pumped into the Yellow Creek Station, he shut down the two pumping units at Hattiesburg (the next station upstream of Yellow Creek).

At about 10:38 a.m., three minutes after receiving the initial alarm, the pipeline controller started calling field personnel, directing them to the area of the leak.

[3] Dixie pipeline controllers operate their SCADA system computers at the pipeline liquid control center in Houston, Texas
[4] At 10:40:04, the Unit 1 pump at Butler turned off automatically.

Specifically, he sent two people from Hattiesburg Station and two people from Demopolis Station (the next station downstream of Butler). For the next few minutes the controller, with the assistance from other employees at the control center, began calling personnel at other stations to advise them of the developing emergency situation. He continued to shut down the mainline, and contacted personnel to cease any operations involving injectors.[5]

About 10:41 a.m. the control center began receiving telephone calls. The first call they received was from a resident near Carmichael, who reported a major leak and explosion. The resident provided a description of what she observed (the pipeline controller told investigators, "She told me there was vapor…white smoke") and her home address, enabling the controller to better determine the specific location of the release. This phone conversation got cut off unexpectedly. The pipeline controller then called the Clarke County, MS (emergency) 911, explaining that there was a significant leak in the propane pipeline. He was told that they were aware of this, and had dispatched emergency personnel to the scene.

The control center received additional calls, including one at 10:46 a.m. describing four major explosions and fire 200 feet in the air, along with two columns of white and black smoke. The caller also helped him identify the specific location of the rupture: "Right where Hunt Oil crosses Dixie." Two minutes later, the controller received a call from an official at Hunt Oil, who indicated that Hunt's pipeline was shut down and blocked off in the area of the leak.

Soon after these telephone conversations, the pipeline controller shut Butler Station east suction valve (10:52:37) and west suction valve (10:52:45), and Carmichael Station suction valve (10:56:06), to further isolate the site of the rupture. The pipeline controller continued to shut down the entire pipeline, communicating with technicians at other stations along the pipeline. Later, technicians arrived at the site to shut the east (11:39 a.m.) and west (12:36 p.m.) main block valves near Carmichael.

[5] An injector is an apparatus useful for introducing an additive material into a pipeline.

Timeline of Significant Events at Enterprise Pipeline Liquid Control Center.

*Below is a timeline of the significant events related to the pipeline rupture and subsequent emergency response actions. The information includes the time of the event, data displayed on the SCADA system (at the pipeline liquid control center in Houston, Texas) relevant to a particular pumping station, commands to the SCADA system initiated by the pipeline controller, and telephonic communications.*

| **TIME**[6] | **PUMPING STATION, or TELEPHONE CONTACT** | **INFORMATION from SCADA or TELEPHONE CONVERSATION; PIPELINE CONTROLLER ACTION** |
|---|---|---|
| 10:35:07 a.m. | Carmichael | Flow: 6039 BBLH<br>Discharge: 1079 PSIG<br>Suction: 513 PSIG |
| 10:35:13 | Carmichael | Flow: 7126 BBLH<br>Discharge: 154 PSIG<br>Suction: 146 PSIG<br>Unit 2 pump OFF (Uncommanded) |
| 10:35:46 | Butler | Discharge: 906.4 PSIG |
| 10:35:50 | Yellow Creek | Discharge: 1009.6 PSIG |
| 10:36:25 | Carmichael | Unit 1 pump shutdown (Controller Command) |
| 10:37:01 | Yellow Creek | Unit 1 pump shutdown (Controller Command) |
| 10:37:12 | Butler | Unit 1 pump started (Controller Command) |
| 10:38:20 | Yellow Creek | East valve closed (Controller Command) |
| 10:38 | Telephone Call Initiated | Started calling field personnel to head to site. Sent two people from Hattiesburg Station, and two people from Demopolis Station. Continued to call personnel to halt operations involving injectors. |

[6] The times of the telephone calls received and initiated are approximate.

| | | |
|---|---|---|
| 10:40:04 | Butler | Unit 1 pump OFF (down on low suction) (Uncommanded) |
| 10:41 | Telephone Call Received | Resident near Carmichael reports major leak and explosion behind her house, just outside Carmichael Station. (Phone communication ends abruptly). |
| 10:42 | Telephone Call Initiated | To Clark County 911. Pipeline controller informed them of propane leak. PLC was informed that emergency personnel already dispatched to the scene. |
| 10:46 | Telephone Call Received | Caller describes 4 major explosions, fire 200 feet in air, and 2 columns of white and black smoke; identifies the specific location of leak ("Where Hunt Oil crosses Dixie"). A contractor in the area is directed to site. |
| 10:48 | Telephone Conversation | Hunt Oil employee informs PLC that Hunt Oil's line is shut down and blocked off in area of release. |
| 10:52:37 | Butler | East station suction valve closed (Controller Command) |
| 10:52:45 | Butler | West station suction valve closed (Controller Command) |
| 10:56:06 | Carmichael | Suction valve closed (Controller Command) |
| 11:39 | Telephone Conversation | Field technician reports remote block valve east of Carmichael closed |
| 12:36 p.m. | Telephone Conversation | Field technician reports remote block valve west of Carmichael closed |

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